

King County Fuel Cell Demonstration Project

King County leading the wastewater industry with innovative clean energy ideas.

Working with the U.S. Environmental Protection Agency and FuelCell Energy Inc., King County is sponsoring the world's largest demonstration project of a single-unit fuel cell power plant. Using digester gas from the county's South Wastewater Treatment Plant in Renton, Wash., this fuel cell will produce up to 1 megawatt of electricity, or enough to serve 1,000 households.

King County will use the electricity to run some treatment plant equipment, cutting power costs about 15 percent. The county's wastewater treatment utility protects public health and water quality by cleaning an average of 200 million gallons of sewage a day at its two regional plants in Renton and Seattle.

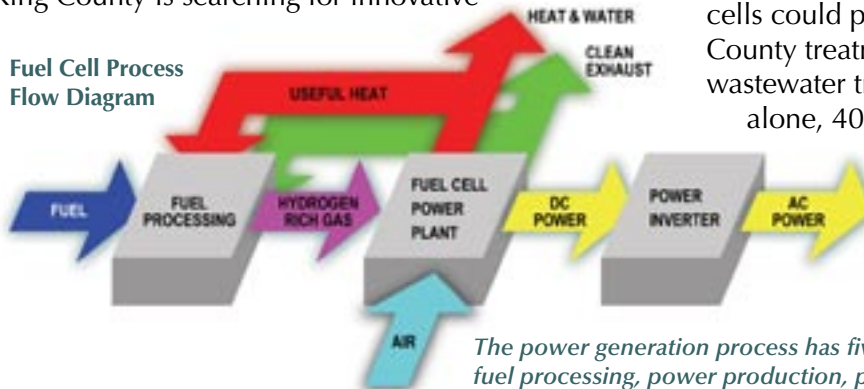
To reduce energy costs and air emissions, King County is searching for innovative

ways to provide electricity for its wastewater treatment plants. The fuel cell demonstration project moves the county into the "green" power arena. Power generated from the fuel cell will be green in at least three ways: It uses a renewable fuel, wastewater digester gas. It produces power efficiently. And it emits fewer pollutants than combustion engines.



1 MW fuel cell power plant at the South Treatment Plant

If the demonstration proves successful, full-scale fuel cells could provide some electricity used at the King County treatment plant and at other municipal wastewater treatment systems. In the United States alone, 400 treatment plants produce enough digester gas to generate 1MW of electricity each, from a stationary fuel cell.



How Does a Fuel Cell Work?

Fuel cells are electrochemical devices that convert chemical energy from fuels containing hydrogen directly to electricity and heat. Combustion is not needed.

Similar to a battery, a fuel cell has hundreds of individual cells. Cells are grouped to form a stack. Each fuel cell contains an anode, cathode and electrolyte. A hydrogen-rich fuel, such as digester gas, enters each stack and reacts with oxygen to produce electricity in each cell.

A typical battery has a fixed supply of energy. But fuel cells are like large continuously operating batteries that generate electricity as long as they get a fuel, such as methane, which is a large component of digester gas.

Fuel Cell Advantages: High Efficiency, Low Emissions

Electricity is typically generated in a two-step process: Fuel is converted to mechanical energy (or heat), which then turns a generator to produce electricity. Fuel cells produce electricity in a single step: Fuel is converted directly to electricity. By dropping the mechanical energy step, fuel cells are more efficient than traditional methods of generating electricity and produce very few emissions.

Uses of Fuel Cells

Fuel cells are defined by their electrolyte, or the material inside them. There are five types of commercial fuel cells: solid oxide, phosphoric acid, alkaline, PEM and molten carbonate. Fuel cells are used for mobile (car), portable (phones or handheld computers) and stationary (power plant) power production.

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King County's South Treatment Plant will use a molten carbonate fuel cell, or MCFC. MCFCs run at a higher temperature and are expected to be 50 percent more efficient than phosphoric acid fuel cells, a type of fuel cell now used at several other wastewater treatment plants, Yonkers, N.Y.; Portland, Ore.; and Boston, Mass.

Just entering commercial markets, MCFCs offer greater fuel flexibility and higher fuel-to-energy efficiencies than lower-temperature fuel cells. The higher operating temperatures of MCFCs make them candidates for applications in which the exhaust heat generates more electricity. When waste heat is used for cogeneration, the total thermal efficiency approaches 80 percent. Without cogeneration, efficiency is about 50 percent.



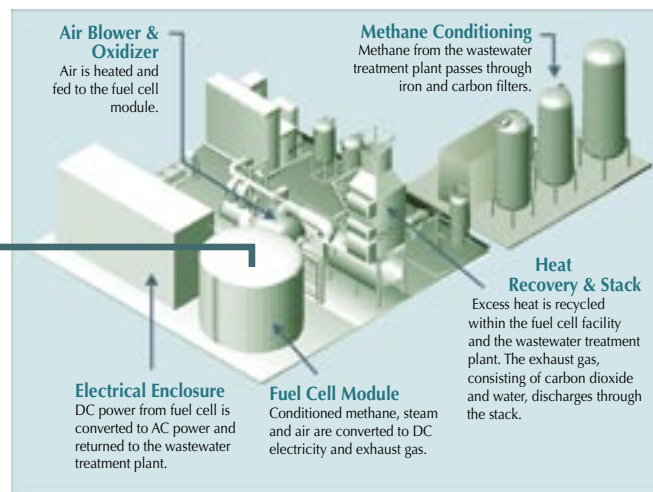
Cutaway view of fuel cell with four stacks inside fuel cell module

The South Treatment Plant Fuel Cell Demonstration Project

The demonstration project will run for two years, 2004-2006. At the end of the demonstration, the county may elect to continue to use the fuel cell as a permanent facility. King County can upgrade the power plant to 1.5 MW if the demonstration proves successful and the county wants to increase power-generation capacity.

The figure (above right) shows the components of the fuel cell at the South Treatment Plant.

An MCFC needs the incoming fuel to be about 1200 degrees Fahrenheit. After the fuel goes through the fuel cell and the hydrogen is consumed, the exhaust gas goes through a heat recovery unit. The treatment plant recovers some of the heat to preheat the incoming fuel entering the fuel cell; the rest is used to produce hot water for the treatment plant.



Source: Brown and Caldwell

1 MW Fuel Cell Power Plant

The fuel cell testing program begins in the summer of 2004. The testing will continue for two years. Every six months, a Peer Review Panel meets to review the test results and provide suggestions on how to optimize the testing program.

Project Partners

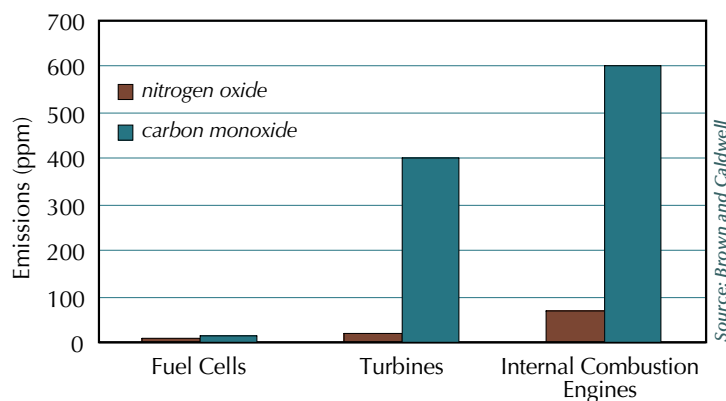
FuelCell Energy of Danbury, Conn., and King County share costs of the South Treatment Plant Fuel Cell Demonstration Project. The U.S. Environmental Protection Agency is providing an estimated \$12.5 million in federal funds to King County through annual cooperative agreements. The total value of the project is \$22 million.

CH2M HILL of Bellevue, Wash., and Brown & Caldwell of Seattle, Wash., are providing engineering services for the fuel cell project to King County. Hawk Mechanical Contractors Inc. of Redmond, Wash., installed the fuel cell.

Alternative formats available

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Source: Brown and Caldwell

Fuel Cell Emissions Compared with Other Energy Sources

FOR MORE INFORMATION



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Fuel Cell Demonstration Project

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